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ABSTRACT

In a study designed to see how students accommodated a new technology, 27 eighth graders used a microcomputer in a middle school science class to access a commercial videotex service containing an electronic encyclopedia as part of an assignment to write a theme. Field observations of computer use and student interviews were used to collect data. Although the students exhibited the usual motivations for learning, such as grades and pleasing the teacher, they accounted for their expressed preference for computers over books by claiming that computers were easier to use, despite clear evidence to the contrary. This rationale lay over a stereotypical vision of personal futures requiring knowledge of computers which motivated them to learn to use computers. Results also showed the greater salience of information obtained from electronic sources than print sources. The students assigned four functions within the school academic and social context to the hard copies of their electronic information--including achievement, reference, content, and interpersonal uses--and valued printouts especially for their portability and alterability. Overall, the students accommodated computers and videotex within their school context but assigned the new technology greater value than traditional learning media. (Author/LMM)

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VIDEOTEX IN MIDDLE SCHOOL: ACCOMMODATING COMPUTERS AND PRINTOUTS IN LEARNING INFORMATION PROCESSING SKILLS

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ABSTRACT

VIDEOTEX IN MIDDLE SCHOOL:

ACCOMMODATING COMPUTERS AND PRINTOUTS

IN LEARNING INFORMATION PROCESSING SKILLS

Field observation before, during and after using a microcomputer to access an electronic encyclopedia showed how 27 eighth graders fit videotex technology within established school communication and learning patterns. Assigned to gather information electronically and from the school's library materials to write a science theme, the students applied science laboratory conventions regarding penalties to their experience with the new technology. Although they exhibited the usual motivations for learning (grades, pleasing the teacher), the students accounted for their expressed preference for computers over books by claiming computers were easier to use, despite clear evidence to the contrary. This rationale lay over a stereotypical vision of personal futures requiring knowledge of computers which motivated them to learn to use computers. Results also showed the greater salience of information obtained from electronic sources than print sources. The students assigned four functions within the school academic and social context to the hard copies of their electronic information--including achievement, reference, content and interpersonal uses--and valued printouts especially for their portability and mutability. Overall, the students in this project accommodated computers and videotex within their school context but assigned the new technology greater value than traditional learning media.

VIDEOTEX IN MIDDLE SCHOOL: ACCOMMODATING COMPUTERS AND PRINTOUTS IN LEARNING INFORMATION PROCESSING SKILLS

Many public schools now routinely use computers in math and spelling drill, in teaching computer programming and, less frequently, in simulations and teaching word processing. Videotex, as a means of accessing an electronic library of information, is another computer use that may be a practical application of the technology for middle, junior and high school teachers without extensive computer training.[1] Introducing a new technology invariably raises questions about its relationship to established media and its functions for those that use it. In a project funded by the Lilly Endowment, 27 eighth-graders used microcomputers in a middle-school science class to access a commercial videotex service containing an electronic encyclopedia as a part of an assignment to write a theme. This paper reports the results of field observations of their computer use and interviews with the students.

This project took place at a small-town middle school drawing primarily from rural non-farm children and the children of blue-collar workers employed at local manufacturing plants, retail businesses and the university. Altogether, 773 sixth-, seventh- and eighth-grade students attended the school at this time, 247 of whom were officially in the eighth grade (approximately age 13). All eighth graders took a science class from one of two teachers, and the project focused on one class of 27 students.[2]

In the laboratory/classroom in mid-September, the participating science

teacher described an upcoming library research and writing assignment, had the students choose a theme subject from a list of science-related topics and conducted some prewriting exercises as prescribed in his manual of lesson plans. Then he continued with his laboratory science curriculum until the month of October. The research team observed in pairs in the science classroom, acquiring familiarity with the style of the teacher and the classroom rules, learning the names and usual behavior patterns of the students while becoming known individually tc the students.[3]

Starting on the first class day in October, the science teacher moved his students upstairs to the media center/library for "research." In the media center, he first introduced bibliographic exercises prepared for this project using books, periodicals and a printed encyclopedia. At the end of the first week in the media center, he introduced his students to microcomputers as a means of accessing an electronic encyclopedia, distributing copies of an operating workbook prepared for this project. He assigned all students to one of nine computers using a rotating schedule giving each student at least four sessions on a computer over a ten-day period.[4] Individual computer-sessions varied from twenty minutes to a half-hour. Seven participant observers served as resource people and took field notes in the computer area during all computer use, focusing on interactive verbal behavior among students or between students and teachers relating to the assignment. The students were also observed while using printed library materials in the media center. Our goal was to see how the students accommodated this new technology.

METHOD

The results reported here come from eight weeks of nearly daily interaction

and observation by two or more research team members. For the entire five weeks the students spent in the media center, three participant observers were present, working informally with the students on the computers and at the library tables. This case study used a focused-inquiry design emerging from on-going systematic analysis of field observations, supplemented by open-ended one-on-one interviews.[5] Our purpose was to understand how this new technology fit into the students' social reality--in other words, to understand how these students accommodated this new technology by examining the meanings (functions, values, understandings, purposes) the students' constructed for the technology.

Observations recorded in field notes provided the raw evidence that each observer expanded in typed form immediately following each field session and later unitized (separating the notes into the smallest interactive episodes). This researcher subsequently categorized each unit following Glaser's constant comparative method.[6] Altogether, 1092 observational units from 62 site visits were collected. This paper focuses on 234 observational units reflecting conversations and interactions while the students were using the computers and computer products--printouts--interpreted within the context of the entire project to locate the social meanings the students constructed.[7]

In addition, 27 student interviews provided accounts from each individual's perspective of the strategic meanings attached to behaviors and motivations, supplying both a tentative confirmation of interpretations and a supplement to the observational data, modified, however, by the constraints of talking to a "teacher." Open-ended questions covered what the students thought they were supposed to do, what they had trouble with, how they solved their problems, how they got their search concepts (keywords), what they were looking for and found or did not find, what they thought about using computers this way. Because of the

limitations of accounts by students to adults, this paper's evidence derived first from observed conversations and behaviors which was then supplemented by the interview accounts. Additional information came from unobtrusive documents such as copies of the students' printouts and their themes. Summaries of the interpreted observations and accounts were reviewed by the students, teacher and other team members ("member-checks") to establish the credibility, dependability and confirmability of conclusions.[8]

RESULTS

The results divide into two portions covering how the students accommodated the computer/videotex technology and how they dealt with their hard-copy printouts of electronic information. Observations showed the students fitting this new technology into their ongoing patterns of student/student and student/teacher relationships, applying established science class conventions and constructing a rationale for their motivation to learn this technology from the teacher's purposes. Interview accounts further illuminate the students' affective reactions and the cognitive context they generated for this new technology.

Accommodating Computers

Because none of the students had prior computer experience, learning to use a computer inspired some initial apprehension, as we might expect. Although the students typically demonstrated increasing self-confidence as they used the computers for a third and fourth time, most found the first experiences intimidating, but some reactions that appeared to be fear can be given a different

interpretation.

Initial Reactions

The following student conversation illustrates their shared apprehension about using this new technology for the first time. As often happens in the school environment, their fear hinges in part on having to be self-reliant:

S: How does this work? [silence]
S: Do we work on this by OURSELVES? [horror in voice]
OS: You go here and here and here.
S: [wailing] I can't do this by myself.
OS: I can't do it in a half-hour.
S: I can't do it by myself.

Another student, on the first day of computer use, ordered an observer to stand behind her: "I want you to stand there because I don't know what's going to happen." Later she repeated the same "instruction" to the media center supervisor. Students who frequently joked with each other, fooled around and talked-back in both the science classroom and the table area, became noticably silent at the computers even when waiting around. And evidence for the class's collective apprehension can be inferred from their dependence on the workbooks containing operating instructions. They clutched the booklets tightly and referred to them constantly during their first two or three sessions on a computer, rarely placing them out of their direct line of sight and asking for them during the interviews--even through some, when asked to try without a book, proved able to log on without one. In addition to using the books for reassurance, students typically called to the teacher and media center supervisor several times in every session to get aid in operating the computer and accessing the electronic encyclopedia until they began to feel comfortable. Student who had relatively little command of the technology would often threaten to repeat a single learned procedure just to use up time and look busy: "I'm gonna push enter til the end of the period." "I'm just going to do moon over and over."

Most of this reaction was normal and predictable, given the newness of the situation. What was more unusual was the students' repeatedly expressed fear of "messing up." Before the start of computer use, most student questions about the assignment appeared to ask about damage ("What if I MESS UP--on the computers?"). The students seemed to think they could hurt the computers, and the teacher responded to their questions by referring to the need for care because of the high cost of the equipment and long distance telephone lines. For example, on their first computer day, several students volunteered remarks like the following to their teacher or the observers: "I never worked with a computer before." "I haven't done this." "I'm afraid of doing something wrong." "I don't want to mess up no computers." Assurances by an observer that the student could not hurt the computer were patently disbelieved ("You can too!"). When a student was asked what might happen if "you do something wrong," the student only muttered, "I don't know..."

Although these reactions appeared to be fear of new technology, they can be interpreted differently in light of the school's science laboratory conventions. The students were actually applying the familiar convention of science laboratory fees covering glass breakage (fifty cents for a test tube, a dollar for a beaker and the like) to the computer situation. By asking about "messing up," these students were striving to find out if penalties applied to accidental error on computers comparable to the set amounts required to pay for laboratory equipment breakage. As a class they made jokes that support this interpretation, worrying aloud about the "cost" of messing up ("I'm gonna be so embarrassed if I flub up. I'll have to pay the school two thousand dollars."). In learning a new technology, then, they were operating without knowledge of the penalties that might arise from their actions, and financial penalties were significant to them.

As the days proceeded, the students gained confidence and later reported (in interview accounts): "It was kind of scary at first. I'm getting used to it. First time, I was really scared thinking I'd screw it up or something." "We know how to use books and can look things up. I was nervous. The thing that bugs me-- I've never used these before--I was afraid to mess up." As typical of classroom experiences, the students reported increasing mastery removed their apprehension: "(The worst thing is) you get lost and it takes forever to get back. After you learn how it works, it goes better." "It's easy to work. Not as bad as everyone says. It was easier than I thought it would be. Using this (modem) was the hardest part." Another reported: "Well, if you press the wrong button, you got off on the wrong track if you didn't know what you was doing."

During the early days of computer use, all observers noted occasional comments at large revealing the students' positive value toward control over the technology. Reactions included: "Wow! Wow! This is cool, you know that!" "Wow! Neat-O! That's total." "THAT was quick." "That's pretty neat." "Man, this is fun. I found it. I found it. This is neat once you get in."

S: There it goes. I'm getting good at this. This is fun. Look [to boy in next carrel]...
OS: [giggles] I could do this all period.
S: This is really fun. [giggles] Watch this. If I hit enter, it just keeps on going!

Similarly, another student discovered the repeat function, insisting that a nearby student watch what he could do: "Look, if I press enter after you get to ... thing, if you press enter three times, it keeps going three times. I'll do it again. If you press it two times, it'll go two times. There it goes!" The numbers of such overt affective reactions, however, decreased over the ten days of computer use. Toward the end of their fourth sessions on a computer, three students (out of nine)

asked to quit early, explaining that they had all the information they needed. Their initial interest in the new technology apparently lasted only about four class periods, and pressure to write their themes then superceded any remaining interest in the new technology.

In interviews, students typically reported (19 out of 27) that using the computers was "fun" or "funner than books"; another 7 expressed other positive reactions while only one student was predominantly negative. A half-dozen volunteered an account of their feeling that the computer gave them a sense of achievement. Despite the short length of computer use (less than two hours per student), eight made unsolicited statements like: "I know how to use computers a little now." "I don't know everything about it, but I can do it pretty well." "I am comfortable that I can figure it out." These statements reveal the scale and the frame of student expectations for themselves; even a mimimum of achievement is enough for self-congratulations: "I had to go back; I pushed the wrong button. Today I didn't do that." "I feel like I know how to USE this." "When I messed up was the worst thing, but I know how to do it now." One girl explained her concept of the difference between using books and computers:

> "...because it [a computer] gave you a feeling of power. Made you feel like you was DOING something. In a book, when you find something, you didn't DO anything. This, you have to DO something to find it!"

In another interview a student proudly claimed: "One day I never lost nothing! I did everything right." These comments go beyond the usual student need to demonstrate achievement to "teachers." They reveal the context in which the students placed this new technology, a context of competitive choice between print resources and electronic text--in spite of the assignment's requiring the students to use both media and the teacher's convincing expression of positive values toward

print as well as computers. These responses show the students uniformly choosing the electronic media over the print media as a learning tool.

Motivations for Learning Computer Technology

The question of the students' motivation to learn to use this new technology is especially interesting because the technology is not "user friendly." It has been claimed that clairvoyance is required to use the reference materials on commercial videotex systems. The electronic encyclopedia itself is far from logical, and the communications software imposes further roadblocks. Therefore, we wanted to know why the students made the effort to conquer these irrational operations and persisted in finding their information despite the fact that finding specific information was often wholly serendipitous. The students' conversations and interview accounts contained four reasons. These included the usual school motivations but also revealed the students assigning a larger personal relevance to this project.

Observations Relating to Motivation

As could be predicted, many student conversations illustrated the importance of good grades and the desirability of receiving approval from the teacher, both normal motivations in the middle-school context. Specifically, the class exhibited a shared understanding that mastery of the computer/electronic text operations would gain the teacher's approval and have positive influences on their overall science grades. A third motivation behind learning computers was suggested by volunteered comments about computers being "easier" than books (or printed library resources). Field notes showed this reason for using the computers shouted out in class in response to a teacher's question and muttered among students

during the teacher's introduction of the electronic encyclopedia ("This is easier than going through all that").

Conversations also displayed a fourth motivation, the job-salience of learning computers. This conversation at the library tables illustrates the future context the students gave to the science assignment:

S_1: "The thing about computers is that everybody'll have to get trained on computers or they won't get a job."
S_2: "Like doctors and everything. By the time you'll get through school and everything, they'll have computers all over."
S_3: "I heard Marsha took a computer class this summer."
S_2: "I don't know."
S_3: "I heard that somewhere, I don't know where.

Accounts of Advantages to Computer Technology

Being "easier" than books was a facet that emerged prominantly in interview accounts, despite clear observational evidence that the technology was in fact more difficult to use than print. Although virtually all students attributed greater ease to using the electronic text than they attributed to using books and printed encyclopedias, on analysis, "easier" had at least four multilayered meanings. The following are student accounts of why they preferred computers over printed encyclopedias or other print materials. (Only three students claimed that using the computers remained frustrating, and two of them still said they preferred computers to books.) None of the students verbally distinguished the computer hardware from the videotex service.

One meaning, asserted by the students in class and in twelve interviews, was that computers are "faster":

"Books take too long. In one hour I can get all the information I need (from a computer). I like the TRS better than those (the Apple computers); they don't do as much."
"Normally, under book form, you have to look under one thing

and then keep looking, and it takes a few hours."
"It takes longer to READ. You learn some (computer processes), and it goes quicker. In just a week, why we got all this information PLUS we learned something about computers!"
"It's a lot easier than going through an encyclopedia and taking all the time for that. You just push the buttons, and you get all the information you needed."

Another related meaning (19 out of 27) was that less effort was required of the student, the usual definition of "easier"; this meaning included a preference for not having to read. Ten students referred to their positive feeling from having information "at my fingertips" or "just pushing buttons":

"Here you can just type it, and it finds it for you. Easier. You have to look it up (in books), seems harder. Computer just does it for you."
"Books are confusing. Looking stuff up is easier on the computer than from books. You don't have to read all the way through to find things like in books."
"Books you have to check to see if the subject is in it. Computer you just have to push some buttons, and it tells you."
"Computers put a lot more at your fingertips."
"Didn't have to turn so many pages, just press buttons."
"You don't have to use AUTHORS [tone of disgust]."

The preponderance of opinion (18 out of 27) was that the "computer" had more information than print materials. Most students seemed to feel that the quantity of information on a topic was greater in the electronic encyclopedia than in the printed version of the same encyclopedia or in the books available in their library. Several students referred to the expansion capability of the electronic data base:

"Encyclopedias [printed] don't have it all."
"There wasn't enough in the books."
"[Computer] has more information. This went to Ohio to find out information. They might have more. Books can give you three paragraphs, and you can look in more books, but computers keep going; you get more information. Keep pressing enter, and the information keeps coming in."

"If it was a book, it has to be in a little part on a page [shows small space with fingers]. In the computer, there is as much room as they need."

Another meaning volunteered by five of the students was that the computer's content is more current, and sometimes more appropriate, than the library's books and periodicals:

"Books aren't new."
"It is more up-to-date than the books; I found out more about Dolphin communication from here than from the books.
"The computer gives you all the information you want, not a bunch of junk like the books do."
"In the library, most was just STORIES."

Perhaps the most interesting implied motivation in interviews, however, was the future relevance the students gave to learning anything to do with computers. This motivation implied their personal and social context for learning a new technology in school. They anticipated a stereotypical business and home environment strewn with computers, requiring them to have computer expertise, to which they related this videotex assignment. In interviews, eight students specifically reported the value of learning computers was the experience would eventually help them get jobs:

"It might be our FUTURE someday--computers."
"I like it; there'll be jobs."
"I'll bet this'll help me! It'll help to learn how to do a job or something."
"Later or when we get a job, there's going to be a lot of computers."

Altogether, 15 students pointed out a general future-oriented value to learning to use computers: "It gives you an education. In the future they're going to be used more anyway, so it's a good idea." One student reported that she found the print materials more valuable for writing her report, "But the computer gave me exposure

to the computer." Another wanted to learn computers because "Books we know how to use." Although these values were adopted in part from the classroom teacher, they reveal the students' larger conceptual framework for school learning. One student reported that she found the future she imagined sufficient grounds for overcoming her fear of using computers: "I have to get over it [nervousness]--I need to learn how to use these. This is something I've thought about. I will be using them my whole life." One boy reported: "My dad said I'll probably have to work at MacDonalds if I don't learn how to use one." Another student found less support at home: "My parents aren't interested in computers. I tried to talk about it, but they don't understand." These comments show thirteen year olds worrying about preparing themselves for jobs and uniformly expecting to use computers knowledgeably in their adult lives.

Accommodating Printouts

One byproduct of using computers (in this project's technical configuration) was the hard copy printout. Printouts were a new experience for these students, only faintly similar to xerox copies, that the students chose to accommodate and find meaning for. Out of the total of 127 computer sessions, counting each student each time they used a computer, the students achieved 99 printouts (an overall completion rate of 78 percent). These included the miniscule as well as those repeating identical material, of course, but all students except one generated from two to five printouts.

Conversations and observed behavior suggest that the students in this class attributed at least four meanings to printouts: They were important in the teacher's value structure, demonstrating conquest of the computers or

nonachievement; they provided concepts and page numbers for further work in the electronic encyclopedia; they supplied content for writing themes and using them could substitute for "work"; and, moreover, the length of a printout served a positioning function in interpersonal relationships among students. These shared meanings occurred in both observations and interview accounts, revealing an easy accommodation of an entirely new technology within the students' usual reward-and-penalty system, while also showing greater salience for the new technology than the old.

Achievement Measure

The students had to go through several operational steps to store information in their computer memories ("buffers") and move that information to their disks--later used to generate hard copy printouts. By the time students had been asked by the teacher and media center supervisor two or three times in the same computer session whether they had indeed "opened their buffers," the value of obtaining a hard copy, and demonstrating that fact irrevocably, was entrenched. On one occasion, one boy was asked five times if he had opened his buffer--all within two minutes (by the observer, the supervisor and the teacher, thrice). The teacher said, "Did you get your BUFFER open today? DID you? Did you SEE it say 'buffer open'?"

This idea was so firmly embedded as "right" behavior that it was common to hear wails of "Oh, No! I FORGOT my buffer!" several times in the first week of computer use. One girl thought it was so serious that she hit the teacher on the arm, saying, "Hey! I didn't turn on my buffer." Another girl could hardly bring herself to leave the computer carrel in case her precious information had somehow not been transferred from her screen to her buffer to her disk (which would later be used by the supervisor to generate a printout). Since the process was invisible and

inaudible except for a couple of whirrs, her success was not demonstrable one way or the other until the next day when a printout would appear--or fail to appear.

In the table area, the teacher said more than once, "Those of you who didn't get a printout made some mistake." Although this was not uttered threateningly, it had the effect of imprinting the teacher's value toward obtaining a printout on the students--implying that it would be desirable to get one every time one used a computer. Not getting a printout became the penalty for not mastering the new technology. This was reinforced by the teacher and the supervisor making rounds on the second and following days of computer use, insisting that most students show them that their screens said "**Buffer Opened**.

Students who failed to achieve a printout showed their worry in comments to the teacher or to each other. One student excused himself by saying that he "lost" all his work but knew how to do it again, claiming that "today was just practice." Others showed some anxiety by pointing out that "I didn't get a printout last time," or "I didn't get any information." Observer notes of jubulation in voices when students did achieve a printout, especially a long one, supports this interpretation.

Reference Tool

The observers in the table area during the ten days of computer use repeatedly noted students carefully marking their printouts from one end to the other. They made circles around potential search terms and obliterated text perceived as irrelevant to their research papers. At the computers, the previous day's printout became a tool for relocating within the electronic encyclopedia (by page number) and a strategy for finding desired information (calling up highlighted words). Later content analysis of copies of the students' disk-stored information showed 66 uses of the express command requiring a page number from the previous

printout ("GO AAE-xxx" where "xxx" is a specific page in the electronic encyclopedia). More crucially, the students used 239 search terms which observation showed were largely obtained from earlier printouts.

The use of a printout as a necessary reference document was so well established that one student was able to negotiate the teacher into fetching her printout from across the room while she remained at the computer:

S: [calling teacher over] I don't have my printout.
T: Didn't you get one or did you just not pick it up?
S: I didn't get it. [pause] I need it for a page number, to GO.
[pause; girl remains solidly entrenched at her computer, facing the machine]
T: [reluctantly] I'll get it.

Content Tool

Most students drew the bulk of their theme content from their printouts, choosing the conceptual structure and specifics from the electronic rather than print resources. Although the students having topics inadequately covered in the electronic encyclopedia and those seeking the highest grades made substantial use of printed materials, most of the class referred constantly to their printouts when writing. Printouts provided a hard copy of the material accessed in the electronic encyclopedia, supplying facts, spelling of difficult words, names and dates and so on; they also permitted students to avoid taking lengthy hand-written notes from printed sources (or battling for possession of the limited number of printed volumes). In addition, the class assignment required at least two page citations from the electronic encyclopedia (a portion of the assignment not completed by some students despite heavy use of their printouts).

The students appeared impressed with the quantity of relevant material in the electronic encyclopedia on some topics. One student commented at large to his

tablemates, referring first to his printout, "All this information! (scornfully) I just got a little bit of information out of this whole book." Another student volunteered to the observer in a superior tone that his tablemate had a book open, amid a table spread with printouts, "just so she could have a picture to look at." The poorer students copied directly from their printouts. (Later examination of final themes showed that large sections of encyclopedia content were paraphrased, often without footnotes.) The student speaking first below was noted on three occasions to be copying her printout:

S: You have to have two long pages and then one half, right?
OS: Yeah, if that's all you have.
S: What do you mean, if that's all you have?
OS: If you have more, write more.
S: I'm just going to say my horse dies at the end of the story.
[Observer: How long is yours going to be, Janie?]
OS: Six pages.
S: Well, I'll have a lot too, with all this [fans her printout from which she has been copying word for word].

Accounts from some students also suggested that the electronic text made a difference in their theme content: "Most of the questions I wrote out were [too] easy. I wrote do cats have nine lives. I didn't know what I was doing. And when I saw what we were doing [on the computer], I wrote harder questions." Another student was observed commenting to her tablemate that she had "to do all my questions over 'cause they don't go with this stuff [computer information]." Like other students, this student drastically altered her theme to fit what the electronic encyclopedia contained, allowing the new technology to drive her perception of appropriate conceptual content. This pattern illustrates a greater willingness to adopt cognitive structures from the electronic source than the equally available print sources.

Students who did not appear to be task-directed were likely to elicit personal attention from the teacher in this class. When reminded "to get some work done" by the teacher, a student typically opened up a printout and buried him or herself in it. Studying a printout served as acceptable behavior for several days (substituting for searching the library for print references for their bibliographies or reading other material or writing their themes). Many students decided that manipulating their printouts (tearing them up sheet by sheet, stapling them in groups, crossing sections out, circling words) gave the appearance of being "at work" in the classroom. Tearing and stapling was used by one group of four boys to occupy half of a class period on one occasion. (The amount of stapling stimulated a student at a nearby table to order, "Quit pounding like that!") Their own jokes and sensitivity to observation showed that they understood this activity to be questionable--evident in this sardonic comment: "Now we gonna get written down as students [who] like to waste staples." When another student was asked what he was going to do after spending half a class period stapling, he said that next he'd "cross out what I don't need." Observations in the library table area repeatedly showed large amounts of time devoted either to scanning printouts or using them to compose themes, possibly overlapping activities.

Interpersonal Tool

During the first week of computer use, the students redefined the project's goal from "getting information" (to write a theme) to include "getting the longest printout." On getting a new printout, the typical first gesture was to open it to see how long it was. By the third class meeting (after computer use started), the students rushed to their folders on the bookshelf to see if they had gotten a printout and to open it full-length if they had, generally announcing its length to classmates. The values that length had for the students are illustrated in this

conversation:

FS_1: [to tablemates I didn't make no mistakes! [laughs at self] I got TOO much on it! [laughs and unfolds printout, comparing to those of tablemates] "Mine's the longest one! [prideful] Oh, now I've got EVERYTHING on here!"

Another girl, commented (ruefully) to a nearby observer after she unfolded a short printout, "I didn't do too hot, I don't think." In more than a dozen notes, six observers noted students judging or comparing the size of their printouts. Orally, students at the computers bragged to each other: "I'm getting a LOT of information today." "I got to ... I got way past it. My thing [printout] was about that [gestures] thick." Exchanges between students at the computers like the following demonstrate that length was important irrespective of content:

S: [self-congratulatory tone] I'm going to have a long piece of paper.
OS: You are. I'm going through all this twice.

References to Printouts in Accounts

Only one of the questions in the interview schedule referred indirectly to printouts (asking about sources of keywords). Thirteen of the students volunteered that their search terms came from their printouts, and four more commented on the printout's value for theme content. One student referred specifically to his printout as the measure of his success in figuring out the computer. Six students mentioned printouts as a major positive value of using computers, noting that they found it convenient to have a portable record that they could mark up:

"It gives me information on my own sheet of paper."
"The best part of the computer, though, is that it gives you a printout you can take home and write on. You can't

take an encyclopedia book out and keep it."

In sum, the ready accommodation of printouts within thirteen year olds' social positioning warfare showed the students' willingness to find a role for this new technology and its byproducts. It also illustrates the multiple layers of technology's functions within a given context and how the positive cultural bias toward newness gets applied within a school setting.

CONCLUSIONS

This paper addressed the question of the meanings constructed for this new technology by students. Observations and interviews showed these students incorporating the process of learning to use this new technology within their daily routines, applying conventions from the science laboratory, assigning rewards and penalties appropriate to the classroom and judging videotex search an acceptable science class activity. They showed students placing a value on learning computers that permitted rationalizing computer search as easier than print library work--despite illogical videotex procedures that contradicted this notion. The students tended to assign electronic information greater conceptual value than print information and showed a greater willingness to use (and presumably learn from) the electronic media. This new technology generated only a moderate amount of initial apprehension and was given both academic and interpersonal functions within the school context. Using this new technology met students' criterion of relevance to their lives (to grades and so on) and was understood within the context of the students' future adult lives. Although this technology raises the long standing issue of applied versus theoretical education, it also contains the seeds of potential resolution--if it indeed can encourage the learning of the information

processing skills traditional to classroom education within a highly motivating context.

In this context, "motivating" had several layers of meaning. According to accounts by the teacher, several students who would not normally have bothered with a print resource search in the library made an effort to find and store electronic information for their science assignment. (All but four students eventually completed a theme.) The class overall demonstrated attention to the task of manipulating the computer; very little nontask-directed conversation or activity occurred at the computers. The teacher was not observed to urge students to use a computer or to stick to the job of finding information. In the science classroom and library stacks, however, many of these students were observed to require nearly constant redirection to their task.

At a general level, we must ask what conditions will make videotex feasible for schools, assuming for the moment that other students will accommodate this new technology in a similar manner. Issues of cost and refinement of technology aside, the evidence from observation and interviews in this case study leads to the tentative working-hypothesis that using videotex in schools may be practical under the following four conditions: (1) the presence of a teacher who recognizes but discounts the students' initial apprehension and rewards mastery but does not penalize errors during operational learning; (2) the presence of two or more adults (in the case of several microcomputers) to provide technical assistance throughout videotex use; (3) an educational model for computer learning that recognizes multiple roles for new technologies and the salience of electronic over print media; (4) a formal task-role for printouts. Providing workbooks appeared a practical method of responding to computer-intimidation; group instruction might be another. The presence/absence of a printout appeared to be a sufficient reward/penalty for

mastering (or failing to master) the technology, given the students' motivational constructs. In this case study, the students fit the new technology of computers and electronic text into their established patterns of interaction without protest and with apparent interest. This two-week videotext experience, however, utilized many adults as a constant resource and would, under most conditions, have substantial cost. This study suggests that middle-school educators might employ electronic text as a motivating computer experience without major alterations in the curriculum or school environment provided the budget and support staff were available. From the perspective of the students, this new technology served appropriate classroom functions that were valued by the students.

Footnotes

[1]For reviews of related computer and videotex projects and the associated literature, see Frederick Williams and Victoria Williams, Microcomputers in Elementary Education (Belmont, California: Wadsworth, 1984) and William Paisley and Milton Chen, Children and Electronic Text: Challenges and Opportunities for the "New Literacy" (Palo Alto, California: Stanford University, April 1982).

[2]The class was selected from among the participating teacher's three eighth-grade science classes because it fell in a time period least likely to be disturbed by late buses, home room activities, assemblies and football practice. Because of the school uses a "flip-flop schedule," nearly all classes occupy two alternating slots, one morning and one afternoon.

[3]The project team consisted of an eighth-grade science teacher, the school's media center supervisor, two eighth-grade language arts teachers and seven university researchers. An out-of-state consultant served as an auditor to whom the observers daily mailed expanded field notes. In general, the students construed the participant observers as necessary to learning computer operations; their function was to instruct the students, and mild protests occurred when the observers were initially reluctant to intrude.

[4]Members of the team assembled nine microcomputers (TRS 80s with at least one disk drive) hooked to nine auto-dial modems in nine adjacent carrels in the school's media center. These were connected to nine separate telephone lines so that each student could call the videotex service (CompuServe) independently of all others. One of the computers was attached to a line printer that was used after classtime to print the material stored on the students' disks.

[5]For an overview of the axioms characterizing the naturalistic paradigm, see Egon G. Guba, "The Search for Truth: Naturalistic Inquiry as an Option," paper presented at the International Reading Association, April 1982; see also H. Schwartz and J. Jacobs, Qualitative Sociology: A Method to the Madness (New York: Free Press, 1979).

[6]For details on the method of data categorization, see Barney G. Glazer, "The Constant Comparative Method of Qualitative Analysis," in George J. McCall and J. L. Simmons, eds., Issues in Participant Observation (Reading, Massachusetts: Addison-Wesley, 1969): 216-228.

[7]Those observational units referring primarily to operational processes (procedures for logging on/off, opening/closing buffers), content-related tasks (keywords), print materials (occurring away from the computers) and science laboratory activities (occurring before or after computer use) were removed from the data base for separate analysis. See Susan Tyler Eastman and Donald E. Agostino, James A. Anderson, Eric S. Fredin and Kathy A. Krendl, "Using Videotex in Teaching Information Processing Skills: A Report of the Results of a Lilly Linkage Project," Proceedings of the American Society for Information Science, Bloomington, Indiana, May 1984, forthcoming.

[8]This project also used audits, overlap methods and triangulation; see Egon G. Guba, "Criteria for Assessing the Trustworthiness of Naturalistic Inquiry," Educational Communication and Technology Journal 29, Summer 1981, p. 75-92. See also James A. Anderson, "Criteria for Evaluating Naturalistic Inquiry," paper presented at the Speech Communication Association Convention, Anaheim, California, November 1981.